

Evaluation of Tire Valve Failures on a 2003 Ford F450 XLT Super Duty Truck

VRTC-DCD2041 (EA02-018)

Final Report

September 30, 2003

INTRODUCTION

On March 20, 2003, Jim Hague and Thad Gardner from VRTC visited the Ford Motor Company's Michigan Proving Ground, located at Romeo, Michigan, to evaluate vehicle controllability when a right-front tire valve falls on a 2003 Ford F450 XLT Super Duty. The subject vehicles were 1999-2001 models but a 2003 model is similar for testing purposes.

Also in attendance:

Terri Droneburg, Office of Defects Investigation, NHTSA

Pete Soucheck, Automotive Safety Office, Ford Motor Company

Joe Renouf, Automotive Safety Office, Ford Motor Company

Ray Schneider, F-Series Vehicle Dynamics, Ford Motor Company

Robert Camilleri, Tires and Wheels, Ford Motor Company

Steve Raparsley, Vehicle Dynamics, Ford Motor Company

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Prior to the vehicle evaluation, a brief technical presentation was given by the Ford personnel. This briefing outlined Ford Motor Company's corporate engineering test procedures applicable to the alleged defect and included a videotape of subject vehicles undergoing testing at the Ford Motor Company's Arizona Proving Ground located at Yucca, Arizona. The briefing continued with an outline of the subject vehicle engineering durability testing and functional test procedures and results. The presentation concluded with a discussion about valve stems and tire pressure.

The test vehicle used in the evaluation was a 2003 Ford F450 XLT Super Duty, VIN 1FDXF47F93EA00001, DOM 3/02, Odometer 285 miles. It was equipped with four-wheel drive, dual-rear wheels, a flat bed with roll bar and two weight boxes mounted along the centerline of the vehicle. The tires used were new General LMT 400 225-70R-19.5 inflated to 75 PSI. The vehicle was equipped with what appeared to be an OEM steering stabilizer mounted on the center link. Figure 1 is a VRTC file photograph of a similar 2002 Ford F450.

VEHICLE EVALUATION

The authors acted as the test drivers for the vehicle testing. They agreed that Mr. Hague would be Driver 1 and Mr. Gardner would be Driver 2. They further agreed that Driver 1 would act as an attentive driver and would promptly respond to tire deflations and, if possible, use only smooth and moderate control inputs to

control the vehicle. Driver 2 would act as an inattentive driver and would, when possible, delay responding and initially use aggressive control inputs.

The vehicle was equipped with a device that would cause a tire valve failure on demand. This device was attached to the right-front wheel and could be manually activated from the passenger's seat by a driver's assistant. Ford personnel served as the driver's assistant.



Figure 1 – VRTC File Photograph of a 2002 Ford F450

The evaluation was conducted in five parts on three test courses that consisted of straightaway on asphalt, 200-foot radius left turn on asphalt, and a winding (circular course) gravel road that included numerous changes in elevation.

The test on the straightaway course was performed by driving the test vehicle at 55 mph inside a 12-foot lane. Following some arbitrary delay, the driver's assistant ejected the tire valve from the right-front wheel, causing the tire to rapidly deflate in approximately 4 seconds. The vehicle was loaded close to its GVWR and each driver, in turn, drove one test. Driver 1 also drove one test when just the valve core was ejected from the right-front wheel, causing the tire to deflate in approximately 10 seconds. Later, each driver also drove again, when the vehicle was loaded close to its LLVW rating. These LLVW tests also utilized 4-second deflations.

The test on the 200-foot radius course was performed by driving the test vehicle left onto the marked radius at 35 mph. Soon after maximum roll angle had been achieved, while maintaining the 200-foot radius and 35 mph, the driver's assistant ejected the tire valve from the right-front wheel, causing the tire to deflate in approximately 4 seconds. The vehicle was loaded close to its GVWR and each driver, in turn, drove one test.

The winding gravel road course was traversed in a counterclockwise direction at approximately 45 mph. Drivers drove one lap around the course prior to driving their respective test lap. The lap time for both drivers was approximately 7 minutes. The vehicle was loaded close to its GVWR and each driver, in turn, drove one test. Four valve stem caps had been prepared for this evaluation. Two of the caps had been modified. When installed, these two caps would

simulate a "slow" leak. One of these would cause the tire to deflate from 75 PSI to 2 PSI in approximately 4½ minutes and the other in approximately 6 minutes. The other two caps were unmodified so they would not cause a leak.

The test drivers only knew:

1. There were four caps.
2. At least one cap was unmodified.
3. At least one cap was modified.
4. Only one modified cap, if any, would be installed at a time.

The test was conducted by having the driver and driver's assistant seated and belted in the vehicle. The doors and windows were closed, the engine was running, and the radio was turned on moderately loud. Two groups of experimenters simultaneously approached the front wheels. Working virtually out of sight and hearing of the driver and the driver's assistant, they adjusted tire pressure and installed a special valve cap on each front wheel. The experimenters stepped back and the driver was waved onto the course to begin the run. Neither the driver nor driver's assistant knew if they had a slow leaking front tire and, if so, how long it would take to deflate, and whether it would be the left or right side.

RESULTS

Straightaway GVWR 4-second deflation:

Driver 1 reported that, when the tire deflated, he gently braked and pulled to the side of the road and the vehicle was easy to control.

Driver 2 reported that, when the tire deflated, he began a spike brake stop and the vehicle aggressively pulled to the right. He immediately released the brake pedal, began a gentle-to-moderate brake stop, and slowly pulled to the side of the road. When the vehicle was braked gently or moderately, it was easy to control.

Straightaway GVWR 10-second deflation:

Driver 1 reported that, when the tire began to deflate, he was able to begin a gentle deceleration and start pulling to the side of the road before the tire was fully deflated. The vehicle was easily brought to a stop along the side of the road.

Straightaway LLVW 4-second deflation:

Driver 1 reported that, when the tire deflated, he gently braked and pulled to the side of the road and the vehicle was easy to control. He noted little difference between the GVWR test and the LLVW test.

Driver 2 reported that, when the tire deflated, he began a moderate brake stop and the vehicle moderately pulled to the right. He continued the

moderate deceleration and was able to bring the vehicle to a stop along side the road without undue effort.

200-foot radius left turn:

Driver 1 reported that, when the tire deflated, he gently braked and allowed the vehicle to drift approximately 12 feet to the outside of the lane as if pulling to the side of the road. The vehicle was easy to control.

Driver 2 reported that, when the tire deflated, he gently braked and continued to steer the vehicle along the original 200-foot radius path. The vehicle came to a stop within the pathway and was easy to control.

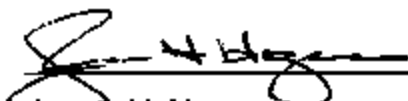
Winding gravel course:

Driver 1 reported that, at approximately 5 minutes into the test run, he began to notice an increased amount of understeer. The understeer was difficult to detect because of the loose gravel that caused the vehicle to either understeer or oversteer almost constantly. At approximately 6 minutes into the test run, he decided that although the vehicle was easy to control something was noticeably wrong with the right front of the vehicle. He brought the vehicle to a stop at approximately 6¼ minutes into the run. He then discovered that the right-front tire was deflated. The experimenters then revealed that a 6-minute "slow leaker" had been installed on the right-front wheel.

Driver 2 reported that, at approximately 4 to 5 minutes into the test run he began to notice an increased amount of understeer. The understeer was difficult to detect because of the loose gravel that caused the vehicle to either understeer or oversteer almost constantly. Since the vehicle was easy to control, he decided to continue. At approximately 6 minutes into the test run, he decided that although the vehicle was easy to control something was noticeably wrong with the right front of the vehicle. He brought the vehicle to a stop at approximately 6½ minutes into the run. He then discovered that the right-front tire was deflated. The experimenters then revealed that a 4½-minute "slow leak" had been installed on the right-front wheel.

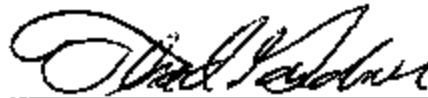
CONCLUSIONS

Both drivers agreed that, based on the tests conducted, the test vehicle presented no unusual or difficult controllability demands upon the driver when faced with a slow or rapidly deflating front tire.



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